

**SECTION 27 30 01**  
**TELEPHONE SYSTEMS**

**PART 1 – GENERAL**

**1.01 SECTION INCLUDES**

- A. Telephone system.

**1.02 MEASUREMENT AND PAYMENT**

- A. Measurement: Telephone systems will be measured for payment as a lump-sum unit acceptably installed and tested for compliance.
- B. Payment: Telephone systems, will be paid for at the Contract lump-sum price for telephone systems, or as part of the lump-sum price for Communications Work, as determined by the lump sum measurement specified above, as indicated in the Bid Schedule of the Bid Form.

**1.03 DESCRIPTION**

- A. Telephone Systems shall include the following:
  - 1. IP Telephony System
  - 2. Emergency Telephone System
  - 3. Fire Telephone System
  - 4. Emergency Call Box System

**1.04 SUBMITTALS**

- A. General: Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.
- B. Functional description of each telephone system and purpose of all proposed test and diagnostic equipment.
- C. Top-down documentation for all IP Telephony System software and firmware. The documentation shall include structured formats or top-level flow charts, functional descriptions, program listings, detailed design descriptions of all algorithms, flowcharts, program design languages or pseudocode, operating instructions, data base descriptions, program logic and data interface diagrams and descriptions, and hardware interfaces. The submittal shall include the following:
  - 1. A functional description and overview of the software

2. An inventory of all software programs and modules, cross-indexed and characterized as standard, modified standard, or custom.
3. A standard that software documentation released by the Contractor conforms to.
4. Documentation on standard software.
5. Documentation on modified standard programs.
6. Functional requirements document, design and specifications document, and program source code for custom-designed software.
7. Complete listing of the database documentation.
8. Complete description of all display formats.
9. Memory map charts of application programs.

## **PART 2 – PRODUCTS**

### **2.01 IP TELEPHONE SYSTEM**

- A. IP Telephony System will be a network based Voice over Internet Protocol (VoIP) Cisco Unified Communications Manager v6.1 or higher. Call control and messaging server clusters to be designed to fail over to geographically diverse servers.
  1. IP network to be configured for Quality of Service to give voice and video traffic priority.
  2. IP phones shall be configured to encrypt voice traffic.
  3. Adequate IP network security shall be provided.
    - a. Servers must run Cisco Security Agent.
    - b. Appropriate firewalls in place to prevent unauthorized access.
    - c. Features shall include:
      - 1) Join Across Lines.
      - 2) Mobile Connect = Single Number Reach with single Voice Mail box.
      - 3) Mobility, transparent movement during ongoing calls.
      - 4) Unity Messaging.
      - 5) Presence.
      - 6) Emergency Responder.
      - 7) Unified Video Advantage.
      - 8) Operations Management Software including:

- a) Cisco Provisioning Manager.
- b) Cisco Operations Manager.
- c) Cisco Service Monitor.
- d) Cisco Service Statistics Manager.

- 9) Gateways, Cisco 3845 Integrated Service Routers geographically diverse for redundancy.

B. IP Telephony System Design:

- 1. The IP Telephony system shall be designed for console-less operation, with dial-up service from IP Telephony sets, manual ringdown service from White Courtesy Telephone sets, direct trunk line 911 connection from Emergency Call Box (ECB) locations, and public address access from selected IP Telephony sets. System shall provide wireless network access points for Cisco Unified Wireless IP phones.
- 2. The equipment shall be of digital solid-state, modular design, utilizing the same Unified Communications Manager with the latest hardware and software technologies available at the time of bid.

Existing Communication Servers are to be used if already in place in BART's network. BART's intent is to build a single Communications Manager cluster to provide call control and messaging for the entire system. Incremental growth may require placement of phones only, phones and gateways and additional server capacity. This will be determined by BART Communication Engineer based on specific circumstances.

- 3. The hardware and software design shall be such that incremental increases in station lines and trunks, and modifications of user data (adds, moves, or changes) may be easily accomplished without affecting service to any existing lines and trunks.
- 4. Dial-up Service: The system shall provide station to station direct dialing, capable of processing calls to/from any point in the District's telephone system. IP Telephony users shall be able to go off-hook and dial any network number, regardless of location or serving IP Telephony System, and the system shall automatically complete the call to a system telephone set or route it over network lines for switching by the existing main PABX at LMA, whichever is applicable.
- 5. Courtesy Telephones: Courtesy telephones shall provide communications between patrons and the Station Agent's booth.
  - a. The telephone switch shall provide courtesy telephone service. These phones shall be installed to provide easy access to elderly and handicapped patrons in accordance with ADA requirements.
  - b. Calls made from courtesy telephones shall be directed to the IP Telephony in the Station Agent's booth(s). If the Station Agent does not respond after 15 seconds or the line is busy, a 2-chime code call shall be broadcast over the

Station Public Address System. The code call shall be repeated every 15-seconds until the call is answered by the WiFi handset.

- c. Telephones in the elevators shall initiate the PA-code call without time delay. These calls shall be redirected to Central Control via the Emergency Telephone System if the Station Agent does not respond to the call within 90 seconds.
  - d. Courtesy telephones shall be designed for hands-free speaker phone operation. A permanently affixed sign shall be provided at each telephone location indicating public phones to be used in case of emergencies if the Station Agent does not respond to courtesy telephone call.
6. Emergency Call Box Telephones: The IP Telephony System shall be designed to provide the functions for emergency call box telephones as follows:
- a. The telephone circuits shall be supervised through the IP Telephony System equipment.
  - b. Lifting the handset in the Emergency Call Boxes shall initiate the IP Telephony System to direct the call to BART Police emergency 911 operations.
7. Power to all components in the system needs to be protected to ensure operation in power outage. This includes network components such as ethernet switches, gateways and servers as well as the telephone instruments. IP telephones can be powered by:
- a. Power over Ethernet.
  - b. Power injectors in the wiring closet.
  - c. Power cubes for each telephone at the desktop.
  - d. PoE ports and IP phones must support Cisco Discovery Protocol.
  - e. Analog phones receive power from VG gateway.

C. IP Telephony Servers and Gateways Requirements:

- 1. Rack mountable inside a communication equipment cabinet. Alternative mounting arrangements are acceptable subject to District approval. Physical dimensions, construction, mounting data (wall and/or floor), and enclosure locking mechanism shall be submitted.
- 2. Employ a four or five-digit dial plan compatible with BART standards. The software shall have an automatic routine that performs number analysis to the third digit. The software must determine if the number dialed is within the BART's IP network or off net. No access level (e.g. "9") shall be required to dial any network number.
- 3. Interfaces to the Public Switched Telephone Network (PSTN) will be through Cisco 3845 Integrated Service Routers.

4. Cisco VG family analog phone gateways will terminate all analog telephony devices. These gateways convert analog traffic to IP and are under the control of the communications Manager. They are to be placed at the nearest, practical wiring closet to the analog devices.

D. Telephone Sets.

1. Telephone types shall be as specified herein. Wall jacks shall be standard type RJ 45. Plugs shall be RJ-type. Locations of telephones along with the type of telephone and wall jacks to be installed in each location are as shown in the Drawings.

Telephone sets installed at interlocking locations shall be housed in a stainless steel NEMA 4X enclosure.

2. Analog Telephone Sets:

- a. General Requirements:

- 1) One-piece G6 type handset with hearing-aid compatible receiver and noise-canceling transmitter;
    - 2) Non-modular, 3 feet length, vandal-resistant, low-risk exposure handset cords;
    - 3) Dual-gong, electromechanical ringer; and
    - 4) Audio gain control, with a range of +8 to +12dBA, via a handset-mounted thumbwheel.

- b. IP Telephone Sets shall be:

- 1) Cisco Unified Phone 7965G where indicated.
    - 2) Cisco Unified Phone 7945G where indicated.
    - 3) Cisco Unified Wireless IP Phone 7921G where indicated.
    - 4) Cisco Unified IP Phone Expansion Module 7914 where indicated.

- c. Courtesy Telephone Sets:

- 1) Color: White, Elevator: Stainless Steel
    - 2) Model: Gai-Tronics Model No. 297, ADA Compliant.
    - 3) Elevator Cab telephone model: Gai-Tronics Model GTA 06024

- E. The Contractor shall develop and implement a Network dial plan that shall update the IP Telephony Systems currently in service and incorporate those which are being supplied as part of this Contract. This plan shall also integrate the new equipment with the current Direct Inward Dialing (DID) and BART Telephone Network Dial Plan. The proposed Plan shall be approved by the District prior to implementation.

- F. Systems conforming to the above requirements shall be compatible with Cisco Unified Communications Manager v6.1 or higher release.

- G. BART shall be placed on the PABX supplier's mailing list to receive announcements of the discovery, documentation, and solution to software problems, new software releases, and other improvements that could be made to the software furnished with the IP Telephony systems. This information shall be made available for 15 years after final acceptance.
- H. Network Requirement:
- I. As the network becomes more and more congested. Special requirements are need on all switches and routers.
  - 1. High Availability with Dual Switches and Routers on Campus Distribution and Core Layers
  - 2. Quality of Service (QOS) within all VOIP areas
  - 3. Resource Reservation Protocol (RSVP) within WAN areas for heterogeneous networks

## **2.02 EMERGENCY TELEPHONE (ET) SYSTEM**

- A. Existing System Description:
  - 1. The ET system consists of telephone sets installed in stations; wayside facilities including train control houses, ventilation structures, and traction power facilities; along the trackway in Emergency Trip Stations. Emergency telephone sets in the Station shall be installed in or near the Platform Trip Stations, and in the Emergency Management Panel Room.
  - 2. Lifting the handset at any emergency telephone location places the caller on an immediate connection with the LMA operator at Central Control and in the Station Agent's booth of the covering passenger station. Location of the calling party is displayed on the visual display at Central Control, and magnetic tape recordings are automatically made of the entire conversation.
  - 3. Lifting the handset initiates one-way inbound signaling to Central Control. The calling party receives a "ringback" tone to indicate that the call to Central Control is ringing. The Central Control operator answers the call by depressing the flashing console selector button after lifting the red emergency telephone (ET) handset from its console hook. The ringback tone is removed when Central Control answers.
  - 4. The Station Agent can also initiate a call to Central Control over the emergency telephone system.

## **2.03 FIRE TELEPHONE (FT) SYSTEM**

- A. Existing System Description:

1. The FT system consists of telephone sets installed in 14 below grade Passenger Stations, at the middle of each platform, at mezzanine near the fire alarm panel, at emergency exits, and at street level Command Post. Jackboxes are installed at a Fire Radio Call Box, at cross passages in below grade wayside tunnels (Berkeley Hills Tunnel and Transbay Tube), and at fire hose or standpipe locations.
2. The FT system provides audio communication and visual signaling between handsets located at street level and on each side of platform level below ground and on each jackbox location. The system is a dedicated closed loop design where all handset and jackbox locations on the "party line" can communicate with each other up to six (6) handsets simultaneously.
3. Lifting a handset from the hookswitch or plugging into a jackbox location turns on a normally off strobe light located above the telephone set, this in turn would begin to strobe at all locations on the system. The light continues to strobe until all parties hang-up and remove handset from jackbox.
4. The handsets and strobe lamps are connected by a single communication cable providing conductors for both audio and signaling.
5. The fire telephone system and strobe lamps are battery powered under constant charge. In the event of loss of AC power, the batteries will have enough capacity to operate the system for 200 hours. The batteries and chargers are located in the Train Control Room.

B. FT System Requirements:

1. The fire telephone system shall be designed in accordance with the technical and operational requirements of the existing FT as described above.
2. Fire Telephone handsets shall be provided in underground stations as indicated. Jackboxes shall be provided in subways and tunnels as indicated.
3. Major components and devices for the FT system shall include the following:
  - a. Telephone handsets with hookswitch and portable handsets shall be of rugged and durable construction and intended for emergency applications. Handsets installed in station premises shall be either pole or wall mounted units. Portable handsets shall have a shoulder strap carrying case. The handsets shall be a push-to-talk amplified unit with an armored cord.
  - b. Jackboxes shall be yellow in color and shall contain one standard telephone jack (tip, ring and ground sleeve). The box shall be weather resistant with a spring loaded or gravity-drop door. The jacks shall have corrosion resistant contacts (gold plated) and wired to a four position terminal strip in the box.
  - c. The batteries shall be sealed lead-calcium type designed with a life expectancy of twenty years. The battery charger shall be current limited with short circuit protection for 120 VAC input and filtered DC output. The battery shall be sized to provide full operation at room temperature for ninety minutes after loss of normal power.

- d. Telephone enclosures shall be weatherproof and constructed of die-cast aluminum. The enclosure shall be lockable with yellow color and mark with "TELEPHONE" on the door. All hardware, including straps for pole mounting shall be stainless steel.
  - e. The strobe lamps with a yellow colored dome shall be designed for surface or pole mounting. The housing shall be aluminum die-cast or stainless steel with stainless steel hardware. The flash rate of the lamp shall be 80 flashes per minute rated at 1,000 effective candlepower with a peak candlepower of 75,000.
  - f. Other miscellaneous materials including cables, conduit and fittings, pull boxes and termination blocks shall be as specified in Section 20 70 26 - Common Materials and Methods for Electrical Systems, and Section 20 50 13 - Raceways for Facility Services
4. A connection shall be provided at each passenger station such that monitoring (recording) shall be possible at the LMA Central Control.

#### **2.04 INTERCOM SYSTEM**

- A. An intercom system shall be provided at end-of-line Stations.
- B. The intercom system shall provide communications between the Supervisor's Booth and the Employee Lounge/Break Room.
- C. Communications between room locations shall be hands-free after initially pushing a call button.
- D. The intercom unit in the Supervisor's Booth shall be provided with volume control adjustment.
- E. The intercom unit in the Supervisor's Booth shall be a Desk-type, and in the Employee Lounge/Break Room shall be a wall-mounted unit.

#### **2.05 EMERGENCY CALL BOX**

- A. Emergency Call Boxes (ECB) shall be located, as shown on site plans, for parking lots and parking structures to provide a direct line to BART Police Dispatch via the 911 emergency assistance feature of the Telephone switch.
- B. Communications shall be hands-free after initially pushing a call button.
- C. A blue light with emergency strobe will be provided at each ECB location.
- D. ECB telephone, strobe light and housing will be weatherproof.
- E. ECB housing will be provided with appropriate ADA approved signage.



## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. Station wiring for all telephone systems shall be four-pair telephone CAT 5E cables. Station and feeder cables shall not be spliced together.
- B. The power source for all telephone systems (except for the fire telephone system) shall be fed from the DC distribution power panel.
- C. Quantity and approximate locations of telephone system equipment are shown on the Contract Drawings.

### **3.02 TESTING**

- A. Testing shall be performed in accordance with the requirements specified in Contract Specifications Section 01 45 24 - Testing Program Requirements. The following tests shall be performed on each telephone system to demonstrate the above named features as applicable:
  - 1. Station to station calling.
  - 2. Station to trunk calling.
  - 3. Trunk to station calls.
  - 4. Initiate traffic to/from the system that shall activate the various progress and signaling signals/tones generated by the respective system:
    - a. Dial tone.
    - b. Station busy tone.
    - c. All trunks busy (congestion) tone.
    - d. Ringback tone.
    - e. Station ringing.
    - f. Distinctive ringing.
    - g. Delayed ringing at LMA Central (90 seconds for Elevator intercom to ET system).
    - h. Maintenance and Administration data is received, accepted, and transmitted in accordance with District and manufacturer's specifications.
    - i. Transmission and signal levels across all interfaces with other systems and subsystems.

**END OF SECTION 27 30 01**